Furthermore, a temperature control with manipulating intervention in the fuel feed is known. This form of control is superior in control quality to the control of the mass flow of the raw material charge, as can be seen from Fig. 2. The same disturbance in the material feed to the reactor is compensated for by a change in the fuel mass flow (fuel feed) and leads to the reactor temperature already assuming the desired set point again substantially quicker.

All of these controls therefore have the disadvantage that a control deviation (temperature deviation) first has to be discovered in the reactor before the energy input can be correspondingly adapted and the control deviation corrected as a result. A further disadvantage is the strong dead-time behaviour of such reactor systems (big masses of brick lining and high product inventory). In some processes, however, even just brief temperature fluctuations lead to losses in the product quality.

Description of the invention

Object of the present invention, therefore, is to control the process conditions, in particular the temperature, in a reactor as constantly as possible to a set point predetermined in relation to the process.

In a method of the type mentioned at the beginning for controlling e.g. the temperature, this object is essentially achieved in that the material quantity transported in the conveying line is determined and is used as control variable and/or disturbance variable for controlling the process conditions, in particular the temperature. This has hitherto not been conventional practice in the case of granular material, because the determination of the material quantity in a conveying line in the case of granular material is very complicated. However, by virtue of the fact that, according to the invention, the material quantity fed to the reactor

is determined in advance, namely in a conveying line to the reactor, and this variable is used directly as control variable and/or disturbance variable for the control, possible fluctuations in the reactor temperature become apparent in advance and can be corrected before a change in the temperature or other process conditions occurs due to the changed material quantity entering the reactor. The method of controlling the temperature in a reactor, according to the invention, is thus also quite generally a method of producing constant process conditions in a reactor, in particular in order to keep the temperature in and/or the material feed to a reactor (material charge introduced into a reactor) of a plant constant.

To this end, according to a practical refinement of the idea according to the invention, the material quantity in the conveying line can be controlled to a predeterminable value. In this case, the material quantity is a control variable of the control. The method according to the invention therefore constitutes a control of the material charge introduced into a plant having a reactor in which the material in particular is heated, the material being introduced into the plant via a conveyor for example and being transported by a conveying line directly or via intermediate stages to the reactor, the material quantity in the conveying line being determined and being controlled to a predeterminable value. As a result, the material quantity introduced into the reactor is kept essentially constant, so that, in the reactor, fluctuations in the material quantity which may cause a temperature difference and/or a change in the stoichiometry do not occur or are minimized.

The material quantity in the conveying line, in a simple manner, can be controlled by a conveyor, with which the material is introduced into the plant, in particular by varying the rotational speed of a material-charging screw and/or by a weighfeeder (proportional weigher belt) upstream of the material-charging screw. This control eliminates the production-reducing effect of temporary deposits of the material-charging screw for the case where no weighfeeder is pre-

be taken into account in the control of the heat supply. In particular if the material is already (pre)-dried when the material quantity is determined, the short dead time until the material is actually introduced into the reactor can be taken into account especially accurately on account of the constant process conditions.

A possible material discharge between the determination of the material quantity and the feeding of the material into the reactor is preferably also determined if need be and is taken into account during the control, in particular of the material feed and/or of the heat supply. Such a material discharge may be, for example, a reactor bypass in which material is branched off before the feeding into the reactor and is mixed again with material treated in the reactor after this material treated in the reactor has been discharged. Such a bypass mass flow must be deducted, for example, when determining the heat or fuel requirement.

In order to reduce disturbing effects when determining the material quantity, in particular due to residual moisture of the raw material introduced, and in order to eliminate the effect of the material moisture during the delivery of the material into the plant, the material may advantageously be dried and/or preheated before the determination of the material quantity in the conveying line. In particular, constant measuring conditions then prevail, so that the effects of the material introduced into the reactor on the temperature prevailing in the reactor can be accurately estimated and taken into account by the control.

An especially preferred possibility according to the invention for determining the material quantity of the material introduced into the reactor consists in the measurement of the pressure and/or of the pressure loss in the conveying line upstream of the reactor. Such a conveying line may in particular be an airlift, with which material is conveyed upwards. The measurement of the pressure or of the differential pressure between start and end of the conveying line of the airlift allows the amount of material which is transported to be accurately dedu-

ced. According to the invention, it has been found that this method can be used very accurately even in the case of granular material without recourse to density measuring with radioactive material for example.

This control can be used in a multiplicity of reactor types. According to special refinement of the method according to the invention, a gas/solid suspension can form in the reactor, for example as a circulating fluidized bed. In these reactor types, for certain processes, for example calcination, it has proved to be especially important and advantageous that the reactor temperature can be accurately maintained within marginal fluctuations. The methods described above may be used, for example, for the temperature control of a reactor having a circulating fluidized bed during alumina calcination. In particular moist hydrate, for example, can be introduced as raw material into the plant.

The present invention also relates to a plant for the heat treatment of material fed to a reactor, in particular for carrying out the method described above. The plant has a conveying line for the transport of granular material to the reactor and at least one control. According to the invention, the control is connected to a measuring device for determining the material quantity of the granular, in particular fine-grained, material transported in the conveying line to the reactor. As a result, the disturbance variables of a fluctuating material delivery and moisture can be taken into account by the plant control in order to correct the process conditions in advance, in particular the reactor temperature and the material charge introduced into the reactor, and thereby keep the said process conditions constant.

According to a special embodiment, the conveying line is a fluid-pressure conveying line, in particular a preferably perpendicularly arranged rising line of an airlift. It has been found that, in contrast to conventional methods of determining the quantity of fine-grained material which is transported in a conveying line, the